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metric measures

JOURNAL OF WEIGHTS AND MEASURES

40 NAYE PAISE

THE PUBLICATIONS DIVISION

ABBREVIATION FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUB-MULTIPLES

Prefix	Value in Terms of Unit	Abbreviation
Kilo ..	1,000	k
centi .	$0{\cdot}01(10^{-2})$	c
milli ..	$0{\cdot}001(10^{-3})$	m
micro ..	$0{\cdot}000\,001(10^{-6})$	u

(2) WEIGHTS

Denomination	Value	Abbreviation
tonne ..	1,000 kg	t
quintal ..	100 kg	q
kilogram ..	1 kg	kg
gram ..	1 g	g
milligram ..	1 mg	mg
carat ..	200 mg	c
(3) CAPACITY		
kilolitre ..	1 000 1	kl
litre ..	1 l	l
millilitre ..	1 ml	ml
(4) VOLUME		
cubic metre ..	m^3	m^3 or cu m*
cubic centimetre ..	cm^3	cm^3 or cu cm*
cubic millimetre ..	mm^3	mm^3 or cu mm*
(5) LENGTH		
kilometre ..	1 000 m	km
metre ..	1 m	m
centimetre ..	1 cm	cm
millimetre ..	1 mm	mm
micron ..	1/1 000 mm or 10^{-3} mm	um
(6) AREA		
square kilometre	1 000 000 m^2	km^2 or sq km*
square metre ..	1 m2	m^2 or sq m*
square centimetre	1 cm^2	cm^2 or sq cm*
square millimetre	1 mm^2	mm^2 or sq mm*
(7) LAND MEASURE		
are ..	100 m^2	a
hectare ..	100 a	ha
centiare ..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20 g, 5 g, 10 t. 20 ml, 271, 165 km, 2 mm, 100 cm^3, 66 km^2.

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM; the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.

(3(Do not use any other abbreviations except those given above.

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Eighth Conference of Controllers

THE Eighth Conference of Controllers of Weights and Measures was held in Agra on 5, 6 and 7 March 1964. Shri P.N. Nayer, Director of Weights and Measures, Ministry of International Trade, presided. Controllers of Weights and Measures of the States and Union Territories and representatives of the National Physical Laboratory (NPL), Indian Standards Institution (ISI), Directorate General of Technical Development and Ministries of International Trade, Law, Finance, Information & Broadcasting attended the Conference.

Inaugural Speech

The Conference was to have been inaugurated by Shri Jagmohan Singh Negi, Minister, Food and Civil Supplies, Uttar Pradesh, but he was unable to be present in person. His speech inaugurating the Conference was read by Shree G.P. Mital, Controller of Weights and Measures, U.P. The Minister welcomed the delegates from all parts of India. Agra besides being a city of historical importance was the biggest centre for the manufacture of commercial weights in the country. The Agra industry had made a significant contribution to the success of the reform of weights and measures in India. The introduction of the metric system of weights and measures would bring much benefit to the country. The task of changing to a new system of measurement was big, but it had been successfully accomplished through the cooperation of trade, industry and the general public. He wished the Conference success in finding solutions to various problems which still confronted the authorities responsible for enforcing the metric system.

Shri G.P. Mital, Controller of Weights and Measures, U.P. referred to the progress achieved in the enforcement of weights and measures in the State. The State had a late start, but had succeeded in catching up with the rest of India.

Chairman's Remarks

In the absence of Shri C.S. Ramachandran, Joint Secretary to the Government of India, Ministry of International Trade, Shri P.N. Nayer, Director, Weights and Measures, presided over the Conference. He referred to the services rendered to the reform of weights and measures by Shri K.V. Venkatachalam who had presided over the first seven Conferences. The Conference placed on record its appreciation of the outstanding services rendered by Shri K.V. Venkatachalam to the reform of weights and measures, to the building up of Weights and Measures Organisations in the States and to the evolution of the Controllers' Conference. The Conference also decided to convey to Shri Kanwarjit Singh, Adviser on Weights and Measures to the Royal Saudi Arabian Government, its congratulations on his selection to his present assignment and its good wishes for success in his new tasks.

The Chairman spoke of the importance of technical training of personnel for enforcing weights and measures. The enforcement of

weights and measures was a higly specialised task. It required the use of complicated equipment and the employment of highly trained personnel. Weights and Measures Departments in the States had been provided with costly equipment in the form of Standard Weights and Measures and precision balances. It was of the utmost importance that Inspectors of Weights and Measures should be adequately trained to make the best use of their equipment. A large proportion of the Inspectors in service had yet to receive formal training. This could not be helped since with the limited training facilities available, it was not possible to train every Inspector in an Institute before inducting him into Office. Training facilities had since been improved and expanded. He hoped that Inspectors who had not received formal training would be sent in convenient numbers to the Bihar Institute of Weights and Measures for training.

The main conclusions and recommendations of the Conference are summarised below.

(1) Progress of Enforcement of Metric Weights and Measures

Metric weights had come into exclusive use all over the country, barring certain isolated areas, and unorganised trades like the trade in fruits and vegetables. The campaign to eliminate unauthorised weights and measures from these areas and trades would continue.

(2) Organisation For Enforcement

(*a*) *Status :* The Enforcement Organisation had statutory functions of a permanent nature. It should, therefore, be made permanent. Unless this was done, it would be difficult to recruit competent personnel or to retain the services of able men serving in the Organisation. The value of training imparted to Inspectors at considerable expense to Government, and their highly specialized experience would be lost, if due to the temporary nature of their employment they were compelled to seek opportunities elsewhere.

(*b*) *Strength :* Weights and Measures Departments should be staffed on the scale recommended by the 5th Conference of Controllers of Weights and Measures.

(*c*) *Financial Situation :* In many States, Weights and Measures Departments had become financially self-supporting. Other States should aim at becoming financially self-supporting, as soon as possible.

(*d*) *Equipment :*

(*i*) *Working Standard Weights:* The Mints have met the demand for Working Standard Weights in full.

(*ii*) *Secondary Standard Length Measures*: The Bombay Mint would begin manufacturing these standards soon. They would supply at least one standard measure to each State and Union Territory in the course of the year. On the basis of 1 secondary standard length measure for every 10 working standard length measures, the estimated demand for the whole country would be 80 to 100 standards.

(*iii*) *Secondary Standard Balances :* Secondary standard balances should be of the following capacities and sensitivities :

Capacity	Per division of the scale
20 kg	25·0
5 kg	7·5
1 kg	1·5
50 g	0·4
2 g	0·02

The lengths of the beams and other particulars of design would be left to the manufacturers, but the suggestions of the National Physical Laboratory would be circulated to them for guidance. The specification would be sent to the approved manufactures of Inspector's balances. They would be advised to submit prototypes for test to the National Physical Laboratory.

(*iv*) *Equipment for Marking Glass Measures:* A firm was working on a prototype of the sand blasting equipment designed by the National Physical Laboratory. If the firm failed to supply a prototype by the end of June 1964, or if their prototype was not of satisfactory quality, the manufacture of the equipment would be undertaken by the Bombay Mint.

(*v*) *Test Weights :* Commercial cast iron weights of 20 kg, adjusted to a high accuracy, should be used as test weights, except for testing very heavy weighbridges. The Mint Master, Bombay, would design roller type test weights for verifying heavy weighbridges.

(*vi*) *Test Measures :* Special test measures of the denominations 1 litre, 2 litres, 5 litres and 10 litres would be designed for verifying commercial measures, dispensing pumps and filling machines. Till these test measures were designed and supplied to the Weights and Measures Departments, ordinary conical measures, adjusted to high accuracy, should be used as test measures.

(*e*) *Training of Inspectors :* It would be enough to provide a single course of training for all Inspectors whether fresh recruits or persons who have been working as Inspectors for sometime. The duration of the course should be 3 months. The course would be conducted at the Bihar Institute of Weights and Measures, Patna which would make arrangements for the lodging and boarding of the trainees. Inspectors should be paid, during training, a fixed monthly allowance in addition to pay.

The general opinion was that the Institute for the training of Inspectors should be under the control of the Central Government. Till the Centre can make adequate arrangements, the Central Government must meet the entire expenditure on the training, through grants to the Bihar Institute of Weights and Measures.

(3) Scope of Enforcement Law

(*a*) *Definition of the term 'Use in transaction for trade or commerce'.*

The Weights and Measures (Enforcement) Acts applied to weights, measures and instruments used in transactions for trade or commerce. It was, therefore, necessary to give a clear and precise definition to the term. The following definition was recommended for adoption in all the States :

'Use in transaction for trade or commerce' means use for the purpose of determining or declaring the quantity of anything in terms of measurement of length, area, volume, capacity or weight in or in connection with—

(*a*) any contract, whether by way of sale, or purchase or exchange or otherwise; or

(*b*) any assessment of royalty, toll, duty or other dues; or

(*c*) assessment of any work done or services rendered, except in respect of research and scientific studies or individual household purposes.

It was important that the scope of Weights and Measures (Enforcement) Acts should be indentical in all the States.

(*b*) *Weights, Measures and Weighing and Measuring instruments used in Transactions for Trade or Commerce in the Sugar and Tea Industries.*

The recommendations made by the Study Groups set up to study the use pattern in sugar and tea industries were approved. (*See* separate article on pp 9-12 in this issue for the recommendations of the Study groups—Editor)

(4) Verification of Contents of Sealed Packages

(*a*) *Verification Procedure*

The Contents of sealed packages should be verified at the place of manufacture or packing. The contents of individual packages, as well as the average content of a minimum of 10 packages should be of the specified accuracies. The limit of error which would be permitted on an average of 10 packages was roughly 1/3 of the permissible error on an individual package. To avoid waste, verification should, as far as possible, be carried out without opening the packages. This is generally possible at the place of packing, where it should be possible to make an estimate of the tare weight by weighing a number of containers.

Sealed packages would be verified at trading premises only if the Inspector had strong reasons to suspect that a trader had been committing fraud by tampering with the packages he received from the manufacturers. If it becomes necessary to open a package, the Inspector should buy the package, paying the full commercial price.

(*b*) *Permissible Errors*

The following errors would be permitted in the contents of individual packages of foodgrains, sugar, infant food, cotton and milk :

Foodgrains : ±0·5 per cent on the net weight of foodgrains, packed in bags holding 90 to 100 kg.
Sugar : ±0·1 per cent on white sugar packed in bags holding 1 quintal.

Raw sugar is more liable to moisture absorption than white sugar. A more liberal error would, therefore, have to be permitted for raw sugar. The National Sugar Institute would collect data both in laboratory and in the field, and recommend the reasonable error to be permitted.

Infant Food :

(*a*) Packages with net content between 1 kg and 2 kg ..	± 3 per cent
(*b*) Packages between 500 g and 1,000 g..	± 4 per cent
(*c*) Packages up to 500 g.. ..	± 5 per cent

Cotton yarn :

	Net Weight	Maximum permissible error
(*a*) Full Bale ..	200 kg	± 10 kg
(*b*) Three-quarter Bale	150 kg	± 7·50 kg
(*c*) Half Bale ..	100 kg	± 5 kg
(*d*) Quarter Bale ..	50 kg	± 2·5 kg

Cotton Cloth :

(*a*) Full Bale ..	1500 m	± 100 m
(*b*) Three-Quarter Bale	1125 m	± 75 m
(*c*) Half Bale ..	750 m	± 50 m
(*d*) Quarter Bale ..	375 m	± 25 m

Milk:

Capacity of Bottle	Permissible error
500 ml	± 10 ml
250 ml	± 8 ml
200 ml	± 8 ml

(5) Amendment of the Weights & Measures (Enforcement) Rules

According to the Weights and Measures (Enforcement) Rules, any weight, measure,

or weighing or measuring instrument seized and detained under the Rules, which is not to be a subject of proceedings in a court, has to be dealt with, one month after seizure, as the Controller may direct. Further, any weight, measure, or weighing or measuring instrument, seized and detained, which is to be the subject of proceedings in a court, has to be produced before the court, and after conclusion of proceedings, taken possession of by the Inspector, and dealt with in accordance with the direction of the court. The Rule refers only to weights, measures and instruments, not to articles seized by Inspectors. The Rule should be amended by adding the words 'or article' after 'measuring instrument'.

(b) Use of Bullion Weights

The rules should be amended to ensure that only bullion weights were used in transactions in bullion.

(c) Use of Beam Scales of Appropriate Classes in Trade

The Rules should be amended making it an offence to use in any trade a beam scale which is not of the class prescribed for that trade.

(6) Licencing of Manufacturers

The Weights & Measures (Enforcement) Acts did not authorise a State Government to issue a manufacturer's licence to a manufacturer outside the State. A licence from the Government of the State in which his establishment was situated would entitle a manufacturer to produce weights, measures or instrument for sale in any part of the country.

(7) Abolition of Commercial Brass Weights Other than Bullion Weights

The use of a hexagonal cast iron weight of 20 g would be authorised under the Weights and Measures (Enforcement) Rules. Manufacturers would be advised to discontinue the manufacture of commercial brass weights other than bullion weights. Commercial brass weights of denominations 20 g to 1 kg would be replaced by cast iron weights, and those of denominations below 20 g by bullion weights. Commercial brass weights already in use would continue to be in use and would be reverified and stamped if they conform to specifications. References to these weights in the Weights and Measures (Enforcement) Rules cannot, therefore, be deleted, so long as appreciable numbers of these weights are in use.

(8) Plating of Metre Measures

Nickel and chromium plating would be dispensed with in the case of brass measures. Mild steel measures should be plated in conformity with the specifications in the Indian Standard : 1068-1958. The Indian Standards Institution would suggest a simple method for testing the quality of plating by Inspectors.

(9) Significance of Term 'Appreciable Movement of the Indicator'

According to the Weights and Measures (Enforcement) Rules, sensitiveness is the least weight which, on being added to or removed from the loading platform or pan, when the instrument is in balance, causes an 'appreciable movement of the indicator' from the equilibrium position. An instrument should be considered sensitive enough if on the addition or removal of a weight equal to the prescribed sensitiveness, there is a perceptible imbalance. It is not necessary to insist that the indicator should move over a minimum distance.

(10) Power to Inspectors to Stop Tank Vehicles on the Road.

An Inspector could enter premises where weights measures or weighing or measuring

instruments were kept for use in trade. But he had no power to stop a tank vehicle or any moblile measure or measuring instrument. The Weights and Measures (Enforcement) Acts should be amended to empower Inspectors to stop such vehicles and to examine whether they had been stamped by Inspector.

(11) Wheel-weighers

Wheel-weighers should be verified and stamped by Inspectors.

(12) Measurement of Lime Shells Etc.

The Indian Standards Institution would be requested to recommend specifications for convenient measures for measuring sand, aggregate, lime, shells etc.

(13) Automatic Bottle Fillers in Dairies

Automatic bottle fillers used in dairies and elsewhere, for filling articles in pre-determined quantities for sale were commercial measuring instruments. The Indian Standards Institution should be requested to suggest a method for verifying automatic fillers.

(14) Calibration of Tank Vehicles Plying in More than One State

Such Vehicles should be stamped on payment of full fees by Inspectors in all the States concerned, but they would be physically verified only in one State. The correctness of this verification would be accepted by Inspectors in the other States.

(15) Marking of Prices or Wages on Dials of Weighing Machines

In tea gardens, pluckers of green tea leaf are paid wages according to the weights of leaf plucked by them. In some gardens in Assam the dials of the balances on which tea leaf is weighed, show two parallel graduations, one showing the weights and the other wages payable. The use of such scales should be discouraged. They have, however, been traditionally in use for a long time, and it may not be possible to ban them outright. The Inspector would not take responsibility for verifying the wage graduations. He would verify only the weight graduations.

(16) Sale of Beam Scales by length

The price of a beam scale should depend on its class, capacity and quality. The length of beam should not be a relevant consideration in determining the price. Controllers would advise their licensed dealers not to quote prices in terms of length of beam.

(17) 9·25 litre Measure for Home Delivery of Kerosene

It was reported that a 9·25 litre measure was being used by certain oil companies for home delivery of kerosene. The measure was carried on cycle rickshaws or other vehicles. The Weights and Measures (Enforcement) Rules do not authorise a 9·25 litre measure. In measuring out kerosene oil for delivery, authorised commercial measures of the denominations 2 litres, 5 litres or 10 litres should be used.

(18) Replacement of Verification Certificate or Manufacturer's Licence

A fee of Re. 1 should be charged for replacing or amending a licence. Certificates of verification would be replaced, where necessary, free of charge.

(19) Miscellaneous

(*i*) *Round Metallic Metre Measures :* Round metallic metre measures should not be authorised for use in trade.

(*ii*) *Platform Machines of Capacities below 50 kg :* Platform machines of capacities 5 kg, 10 kg, and 20 kg should not be authorised under the Rules.

Classification of Weighing and Measuring Instruments in Industries

WEIGHTS measures and weighing and measuring instruments used in 'transactions for trade' are subject to regulation by the State. Weights, measures and instruments used in transactions for trade in industrial establishments must be offered for verification and stamping by Government Inspectors of Weights and Measures annually. Those used in shops and other establishments are to be verified once in two years. The term 'transaction for trade' includes not only buying and selling, but also such transactions as payment of wages or bonus for work done, or the levy of duties by the State or Municipal authorities. Any weight, measure or instrument, in short, which is used in any sort of deal between two parties will be subject to regulation.

The classification of weights, measures and instruments as those used in transactions for trade and of those not so used, has to be considered in detail. Broad instructions should be given to the Inspector of Weights and Measures regarding the weights, measures and instruments which should be regarded as used in 'transactions for trade' and hence falling within his responsibility.

Transactions for trade in the industry, may be broadly classified as follows :

(*i*) Buying raw materials, fuels, stores etc., and sale of products and by-products.

(*ii*) Payment of wages, bonus, etc., to workers.

(*iii*) Levy of excise and other duties on the products of the industry

All weights, measures and instruments used for any of these purposes would be subject to regulation by the State. Weights, measures and instruments used for other purposes, as for instance, in the laboratory for analysing materials, or in various departments purely for process control would not be subject to such regulation.

A classification of the weights, measures and weighing and measuring instruments has been completed for two industries : Tea and Sugar. The following is a summary of the recommendations of the Study Groups set up for the purposes. These recommendations were accepted in the 8th Conference of Controllers held at Agra in March 1964.

TEA INDUSTRY

A study Group comprising the various tea interests, some of the Controllers of Weights and Measures from the States and the Directorate of Weights and Measures, Ministry of International Trade, was formed under the Chairmanship of Shri K. M. Kidwai, Director of Tea Development in the Tea Board. The Study Group met on 4 December 1963 in Calcutta and made the following recommendations on the basis of a survey carried out earlier :

(a) Weighment of green Tea Leaf

In many Tea gardens in West Bengal and probably elsewhere, Salters' domestic type spring balances are used for weighing green

leaves. These machines do not conform to the specifications in the Weights and Measures Rules. The balances now in use may be allowed to run their normal course of life. They would be verified and stamped by Inspectors provided they are accurate within the prescribed limit of errors. But when these machines are worn out they would be replaced not by domestic type machines but by trade type machines which conform to the Rules. The Indian Tea Association would advise its members accordingly.

The estimation of the net weight of tea leaf with accuracy is made difficult by the substantial variation in the tare weight of the basket. Standardisation of baskets would be difficult and may not be practicable. Transferring the leaves into standard baskets before weighment would consume more time and labour and also adversly affect the quality of the leaf and ultimately of manufactured tea. It was agreed that the subject should be studied fully with a view to evolve a workable method to minimise the error in estimating the net weight of green tea leaf due to variation in the tare weight of baskets. Until the recommendations of the Working Group come out, Inspectors would be instructed not to enquire into the fixation of basket tare for leaf weighment.

(b) Machines used in rolling Section, Dryer-Mouth Tea Section and Grading Section

The weighments in these Departments are in the nature of internal checks. The machines were, therefore, not used in trade transactions and are not subject to periodic verification and stamping by Inspectors of Weights and Measures.

Every garden should, however, send a declaration to the Controller of Weights and Measures listing the machines exclusively used in these Sections.

(c) Packing

Most of the gardens sell their entire outputs through auctions. At the auctions, transactions take place on the basis of test weighments at the auction house and not on the basis of the weights marked on the chests. Gardens may, however, sell tea also to local customers at the gardens. These customers would normally accept the weights marked on the chests as correct. Machines which are likely to be used for packing chests for local use should be offered for verification by Inspectors. Tea gardens would not be under obligation to have machines used exclusively for packing tea for auctions verified.

Chests are weighed in the store room for assessment of excise duty. The machines used for this purpose must be verified by Inspectors.

(d) Ration Distribution Section

Distribution of Ration to the labourers is obviously a transaction in trade and commerce. Weights, measures and weighing and measuring instruments used for this purpose, are, therefore, subject to periodic verification and stamping.

The weights and Measures Department would carry out verification of weights, measures and weighing and measuring instruments in tea gardens, as far as possible during the cold season.

SUGAR INDUSTRY

A study Group was also set up to classify the various weights, measures and weighing and measuring instruments used in the sugar industry, under the Chairmanship of Shri G. R. Athavale, Director, National Sugar Institute. Besides the Controllers of Weights and Measures and Directorate of Weights

and Measures, Ministry of International trade, sugar interests were also represented on this Committee. As in the case of the tea industry, a survey of the various weights, measures, and weighing and measuring instruments etc. used in the sugar industry was carried out prior to the meeting of the Study Group. On the basis of this survey, the Study Group made the following recommendations.

(a) Weighing Machines

The following categories of weighing machines are used in transactions for trade, and should, therefore, be verified and stamped by Inspectors of Weights and Measures every year :

(1) Weighing machines used for weighing cane purchased by factories from growers, co-operative societies or other agencies.

(2) Machines used for packing sugar in bags to a pre-determined weight (100 kg.)

(3) Machines for weighing mixed juice, in factories where juice is weighed.

(4) Machines used for weighing molasses or bagasse for sale.

(5) Machines for weighing spirits for sale.

(6) Machines used in Stores Department for the purchase of stores. Machines used exclusively for weighing stores for issue to various departmenfs of the factories, not being machines used in transactions for trade, need not be subject to verification and stamping.

Inspectors and other officials of the Central Excise Department and the States' Sugarcane Departments also have powers to inspect, test and where necessary, adjust weighing machines used for weighing sugarcane. They would continue to exercise these powers, but would report to Inspectors of Weights and Meaures any major adjustments they may find necessary to make in these machines.

Officials of the Central Excise Department also have the power to inspect, verify and adjust machines used in packing sugar in bags. They would, however, report to Inspectors of Weights and Measures any major adiustments they may find necessary to make in these machines.

(b) Litre-Measures

All litre measures used in weighing spirits for sale in distilleries attached to sugar factories should be verified and stamped by Inspectors of Weights and Measures.

(c) Calibration of Vats and Tanks in Distilleries

The quantities of spirits in vats or storage tanks are assessed for the purpose of levy of excise duties by the use of dipsticks or dip tapes and calibration charts. The State Excise Departments would continue to be responsible for the preparation of calibration charts, but the dipsticks or tape used for estimating the depths of spirit in the tanks, should be offered for verification and inspection by Inspectors.

(d) Polariscope

Polariscopes are used in assessing the purity of sugar. The price of sugar exported to foreign countries is related to purity. A polariscope, where it is used for assessment of the purity of sugar for export, is an instrument used in a transaction for trade. No procedure has, however, been framed for the verification of polariscopes. The National Sugar Institute would suggest a method for the verification of polariscope.

(e) Permissible Error in the Net Weight of Sugar in Sealed Bags

According to the relevant Indian Standard, the maximum error permitted in the net weight of sugar in a standard bag of 100 kg is 0·1 percent. The Indian Sugar Mills Association has suggested that the limit should be raised to 0·25 percent. The study Group considered a permissible error of 0·1 percent sufficient for white sugar. Raw sugar is more liable to gain or lose weight due to moisture absorption or loss than white sugar. A more liberal allowance may, therefore, have to be made for raw sugar. The National Sugar Institute would collect data both in the laboratory and in the field on the gains or losses in the weight of raw sugar due to variations in humidity and other causes and recommend to the Study Group what would be the reasonable error to be permitted.

A survey of the weights, measures and weighing and measuring instruments used in the Iron and Steel Industry and the Textile Industry is now under way. The recommendations of this Study Group will be published as they become available.

Development of Length And Area Measures in South India—Part 3

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IN Part 1 and Part 2 of the article, we have examined the ancient traditions of length and area measures in South India, as recorded in Sanskrit and other sources.

It was found that a well-knit, and perhaps unified, use pattern of length and area measures may have existed 5,000 years ago in the Indus Valley civilization. But our knowledge of it, based on only three incomplete pieces of length measures, was too meagre to arrive at any fruitful conclusions.

Examination of the Vedic traditions showed that although names of certain units of length did appear in the Vedas, it was not possible to establish any relation among these units.

It was only when we came to the *Arthasastra* that we could establish a coherent system of length and area measures. As two editions of *Arthasastra*, one differing somewhat from the other, are known to exist, the *Arthasastra* tables were examined using both the texts, the hasta of 28 angula being

taken as 50 cm as established in the articles on capacity measures. [1]

In the wake of the *Arthasastra* period, changes took place in the manner of dividing the 3 hasta measures of 28, 24 and 21 angula. Keeping the length of the principal hasta unchanged, *i.e.* 50 cm, the hasta measures were subdivided by two distinct methods. In the first method the commercial hasta was reduced to 24 parts from the original 28, the other units being adjusted proportionately. According to the second method all the three hasta units were divided into 24 'parts', these constituent 'parts' having proportionate dimensions. Evidence of the use of both these traditions was analysed and the Akbari length and area measures were shown to be related to the *Arthasastra* traditions as modified later.

Area measures based on the *Arthasastra* and other hasta measures were evaluated. The possible variations of these area measures with a view to explain certain traditions in South India were also examined.

It is now intended to analyse the traditional measures of length and area used in South India in the light of the examination carried out earlier.

Length Measures

The mathematical analysis presented so far is of a conjectural nature. We have now to find out whether we can get actual data which indicates the magnitudes of these length and area measures to substantiate the conclusions.

Actual samples of commercial length measures of the old type are now rarely available. There exist, however, records of many measurements carried out by the British in the last two centuries which are available for comparison. In examining these length measures, a certain amount of caution has to be exercised. Quite often units which had been influenced by the British system like the 36 inch yard, were also in use side by side with the traditional units. It is sometimes difficult to isolate cases where such influence is strong and where it is negligible. We have, therefore, to look for the more obvious influences and try to re-establish the original magnitudes of the units.

Another point needs to be stressed. Length measures used for commercial transactions wherein the length alone is to be measured may not necessarily be used for calculations involving areas of fields. This should be evident from the fact that exclusive or special length measures are prescribed for only area purposes even in the *Arthasastra.*

From studies which have been carried out by the 18th and 19th century British scholars and administrators one fact emerges clearly: the most common hasta unit (called moolam in Tamil and Malayalam, moora in Telugu, and mola in Kannada) had an average length of about 19·7 inches or 50·04 cm.

British Studies

Gover, [39] who carried out in 1865 remarkable studies of weights and measures in India, is of the opinion that the common 'hauth' all over India was 19·55 inches *i.e.* 49·91 cm.

Brown [40] (1899) states :

> Moolum (translated covid or cubit) used for cloth, from 18-21 inches (0·4572-0·5334 m). Average about 19½″ or 19⅝″ *i.e.* 0·4953 or 0·4995 m. Subdivided into 24 unglums or finger-breadths.

The most important and comprehensive compilation of weights and measures used in the old Madras Presidency is found in the *Manual of the Administration of the Madras Presidency*, [41] published in 1885. It lists

the known weights and measures of all the districts in the Madras Presidency, with explanatory notes. While commenting on the length measures used in the Madras Presidency the following statement has been made :

> The term (hasta, moolum mooda) is translated cubit but it invariably exceeds the 18 inch cubit of England. In this (Madras) Presidency it averages about 19·7 inches, varying from 19¼ to 20.

The *Manual* does not list the various length measures under each district as it considers it unnecessary 'to refer further to linear measures', after having made the above statement.

Balfour [25] also states that the commercial linear measure called mulum in Tamil and mora in Telugu averages 19½ inches. He states :

> It is always translated cubit, though invariably exceeding the English cubit of 18 inches by 1½ or 2 inches.

The Silberrad Report [42] (1913-14 Committee) says regarding length measures in Madras Presidency :

> The British linear measure is used in most districts in the Presidency, but there are a few districts from which it has not been reported *e.g.* Anantpur, South Canara, Chingleput, Chittoor, Ramnad, Nilgiris and Trichinopoly. In these districts the table of length, 2 cubits or muras, mulams or muzams=1 yard or gaz, is used and a cubit is divided into 2 spans or janas. The cubit has generally been translated as 18 inches but it is 20 inches in Anantpur, 19 or 20 inches in rural tracts of Vizagapatam.

There is, therefore, a valid base for our assumption that the normal hath or its equivalent used generally in commercial transactions in South India was equal to about 50 cm. This is the same hasta that has been constantly used in India from the times of Kautilya and possibly even much earlier.

Certain scales were used as length measures in some trades *e.g.* carpenter's kol *i.e.* measuring rod or mason's kol—tutcha-kol, tutcha-mulam. These were based not on the hasta of 50 cm, but on the paurusha of *Arthasastra,* called bauham in South India. It may, however, be mentioned here that sometimes length measures used for area measuring, may also have been used as length measures for some specialized purposes.

There were in use other hasta units which go under various names. To facilitate reference, the recorded 'length' units in use in South India are collected in Table 1. These are based on various sources indicated under the column 'source'. Ancient equivalents for most of these, though indicated here will be discussed later on in this part and also in Part 4.

TABLE 1—COMMERCIAL LENGTH MEASURES USED IN SOUTH INDIA

Sl. No.	Name of measure	District where used	Length Cm	Length inch	Source	Ancient Equivalents
(1)	Hath (other than 50 cm).	Bangalore	48·51	19·1	43, 44	48·79 cm
		Musalipatam	48·59	19·13	44	48·79 cm
(2)	Gaz, Gajam kol ..	Trichur	71·12	28	45	71·15 cm
		Tellicherry	72·14	28·4	43, 44	71·15 cm
		Palamkotta	75·95	29·9	44	76·2 cm
		Travancore	76·2	30	46	76·23 cm
		Palamkotta	82·96	32·66	44	83·86 cm
		Dharwar	83·18	32·75	43, 44	83·86 cm
		Madurai	83·82	33	25, 41	83·86 cm

Sl. No.	Name of measure	District where used	Length Cm	Length inch	Source	Ancient Equivalents
(2)	Gaz, Gajam, kol	Tirunelveli	83·82	33	25, 41	83·86 cm
		Ramnad	83·82	33	42	83·86 cm
		Travancore	83·87	33·02	43	83·86 cm
		Tirucherapalli	83·87	33·02	25, 44	83·86 cm
		Thanjavur	85·09	33·50	25, 41	85·71 cm
		Tirucherapalli	86·54	34·07	44	85·71 cm
		Hyderabad	89·74	35·33	43, 44	—
		Palamkotta	92·08	36·25	44	91·46 cm
		Tirucherapalli	92·08	36·25	44	91·46 cm
		Palamkotta	92·58	36·45	43	91·46 cm
		Bangalore	97·03	38·2	44	97·58 cm
		Masulipatam	97·16	38·25	43, 44	97·58 cm
		Srirangapatam	98·04	38·5	43, 44	97·58 cm
		Bangalore	98·87	38·9	43	99·09 cm
(3)	Bauham	Salem	194·3	76·5	41	194·36 cm
		Coimbatore	194·3	76·5	41	194·36 cm
		Guntur	200·2	78·8	41	100×2 cm

It will be noted that most of the units presented above have a base in ancient tradition. Strangely enough, practically every unit in Table 1 is derived for land area measurement rather than for use as a length measure of commerce. That is why equivalent length measures are not easily available for comparison directly from length measures. This lends further weight to the conclusion that the usual hath of commerce had a length of 50 cm.

Angulam—Its Peculiarities

Another peculiarity should also be noted. Many of these gaz units were sub-divided into 24 parts. Each part was called an angulam. The angulam, therefore, acquired values which could not be explained in the normal manner as the breadth of the middle finger. The angulam examined in Part 2 had values ranging from 1·79 cm, to 2·08 cm. Some examples would clarify how the length of the angula increased beyond these limits :

The Travancore [46] table runs as follows :

1 angulam =1¼ inches=3·175 cm
24 angulam =1 ko =30 inches=76·20 cm.

The Trichur table [45] is on the following lines :

8 barley-corns=1 angulam=1-1/6 inches =2·96 cm
24 angulam (viral)=1 carpenter's cole=2⅓ feet =71·12 cm.

In Tanjore :[41]

1 angulam =1·4 inches=3·56 cm
24 angulam =gaz of 33·5 inches=85·09 cm

To explain away the Tanjore angula a novel method was devised. The angula was taken as the distance between the thumb joint and the tip of the nail. This angulam was then considered equal to 2 virulcaday or finger-tip-breadths [41] each of 1·78 cm, or the angula of *Arthasastra* ! But the word virulkaday itself was used interchangeably with angulam *i.e.* the 24th part of a normal hasta *i.e.* about 2 cm. We shall have many occasions to present varieties of angulam later on. It would appear that the word angulam was used more often to denote a sub-division of a main unit as we use the words half, quarter etc.

Even the definition of the hasta undergoes a change. In the *Arthasastra* the angula is

the breadth of the middle joint of the middle finger of a medium sized man. If we take 24 of these, they give the measure of 42·86 cm, as we have seen in Part 1. The 50 cm hasta was commonly used for commercial transactions. So the definition of the hasta also undergoes a change. In South India the hasta is taken as the length 'from the elbow joint to the tip of the finger of any *tall man* chosen as the standard. [41] Note that the change is from a 'medium sized' to a 'tall man'.

It will now be clear that there has been a continuous tradition of the use of the 50 cm hasta for ordinary length measurements in South India, dating from the Maurya period or even earlier.

Long Distances

We may also examine certain South Indian traditions for longer measures. The kos was taken as 2,000 danda, the danda being equal to 4 commercial hasta. The coss, therefore, works out at 4 km, the hasta being taken as 50 cm. [41] This corresponds with the krosa of *Lilavati*.

There was, however, another unit which was also commonly used. It was called nali-vali and is derived from *vali*, a road or way, and *nali*, which is equal to the 60th part of 24 hours or 24 minutes. The distance normally walked in 24 minutes is called nali-vali. This is a very vague unit of measuring distance and there can be large variations in its actual value. This distance is estimated to be about 1½ miles (2·4 km). The kadum is a more reliable unit and is usually taken as 10 miles or 16 km. Seven nali-vali were also supposed to make a kadum. The kadum is obviously equal to the yojana of 16 km recorded in the *Lilavati*. No other outstanding measures of distance have been noted in available literature.

Land Areas and Revenue

Having considered briefly how the length measures in South India were related to the ancient traditions of metrology in India, we can now examine how far area measures, particularly those used for measuring land areas, were related with ancient practices.

Before taking up the actual study, we may consider briefly how certain practices in the domain of land areas could have taken shape in the course of centuries.

Land revenue formed an extremely important source of revenue for ancient Governments. Great care was usually taken in assessing it.

The land was first classified, then it was actually measured and the areas recorded suitably. The tax was then assessed. The simplest mode of realising payment was usually in kind, though cash and kind or cash payment were also not uncommon. The amount of produce to be given to the Government depended on the grain sown, type of land use of facilities like irrigation, wells [11] etc. [Book 2, Ch. 24].

Quantity Area Relations

On realising the revenue in kind for a few years, it would be possible to make estimates of the crop yield at a suitable time during the crop season. The Government usually realised its portion of the produce on the basis of these estimates, and if necessary, by actual measurement. After paying in kind for a number of years, the piece of land would be associated with a certain quantity of a given grain and its area would be related with this quantity. This may be one of the sources for the practice of denoting the area of land according to some weight or measure *e.g.* a garce or khari of land would mean the area which would produce that much of a specified grain. Such an area unit is usually very

vague because the yield can vary depending upon the type of land, the efficiency of the farmer, the irrigation facilities used, the rainfall, floods, the quantity of seed sown and so on. Statements of area in terms of produce should not, therefore, be taken to indicate well-defined areas, unless they are supported and corroborated by traditional area measures.

There is a second and perhaps a more reliable quantity-area relation: the area sown with a specified quantity of grain. The approximation here would be nearer the truth as the variants are fewer. Examples from ancient literature are khanduga and putti in the Kannada region and tum in Telugu inscriptions[47]. Even in this case the units had a close relation with traditional area measures. The possible reason for relating area with quantity of seed sown could be that in wet or irrigated lands the yield would not be too dependent on external factors and a practicable ratio could be established among the quantity of seed sown, quantity produced and the revenue to be realized.

Vague Units

Even more vague units than the two types mentioned above are found in ancient literature. The hala or plough of land, often referred to in old Sanskrit and Prakrit charters of the Pallavas, is an example. It is taken to signifiy the area of land which could be conveniently cultivated with a plough and a pair of bulls in a given time[47]. This is estimated to be about 5 acres or 2 hectares [48]

Even the nivartana, which is otherwise well-defined in literature, is sometimes taken to indicate the extent of land bounded by a line travelled by a person starting from a particular point and coming back to it within a specified time[47]. These vague definitions merely indicate etymological meanings and are not to be taken literally.

Ancient Surveys

It is against this background of a mixture of vague and well-defined traditions that we have to examine the variety of land measures in South India. The initial step, *viz.* the actual measurement of land areas for revenue purposes was usually carried out in ancient times at suitable intervals and to great accuracy[49]. Inscriptions of the Vakataka period [49] (3—5 century) show that land was carefully surveyed with the measure prescribed by the State and the areas recorded.

The extreme accuracy of measurements is evident from an inscription on the walls of the Brihadeswara temple at Thanjavur which mentions that the land was measured to an accuracy of $\frac{1}{52,48,800,000}$ of a veli [47,50] (about 2.6780 hectares) for assessment. This fraction is nearly 0.5 mm^2. This astonishing and impossible looking survey was undertaken in 1002 AD in the reign of the Chola King, Rajarajadeva !

Later Chola kings like Kulottunga I (1086 AD) Vikrama (1134 AD), Kulottunga III (1216 AD) also appear to have carried out at least partial surveys of the lands in their kingdoms.

In the Karnataka areas also land surveys were carried out, as for example, in 1100 AD. Krishnadeva Raya of Vijayanagar (C. 1510 AD) is also credited with having carried out a land survey [47]

Variety of Ko

The areas were usually measured with a kol *i.e.* rod or pole of a specified length, which was not necessarily the same in all cases. For example, Rajarajadeva used three

different kol, the Ulagalanda kol, Sirrambala kol and Pangitta kol, each measuring 16 spans in length[47]. In the Chola period, rods of 12, 14, 16, 20 feet (steps) were in use. Besides these, other kol whose names alone but not lengths have come down to us, like the kalinjaik-kol, attu-kol, sri-padakol, maligai-kkol etc. were used. Krishnadeva Raya used a kol of 20 feet (steps) in length, though originally it was said to be 18 feet (Steps)[47]. Other Vijayanagar rods measured 12, 16, 24, 30, 32, 34, feet (steps) in length.[47]

The Kadambas used rods of 4, 12, and 16 spans. Rods of 13 spans, 18 spans, 36 steps, 48 steps were also used. Rods called bherunda kol ganga kol, kaccavi kol varisaik kol and a host of others are mentioned. The length of most of these rods is unknown as physical samples are usually not avaiable for examination. Only in a few temples have some marks been provided to indicate the length of the rods used. These are our main guides, and our further analysis is based on inscriptions. It is from this profusion of measuring rods that we have to trace out traditions. It is impossible to seek out the tradition behind each and every measure, but an attempt will be made to analyse the principal traditions.

Five Inscriptions

In order to understand the more important South Indian traditions in land area measures it is necessary to examine certain inscriptions. The more important of these from our point of view but apparently unconnected with each other are :

(1) An inscription of the Chalukya period (11-13th century) mentions that the mattar consisted of 76 kol[49] [SII, xi, (i), 88].

(2) A second inscription of the same period says that land was measured in terms of mattar and kamma, and apparently 900 kamma made one mattar. [SII, IX, (i), 165].

(3) A third inscription[49,51] says that the Kannada word mattar, was called martu in Telugu (plural marturu), and was identical with the nivartana.

(4) The fourth inscription, in which fortunately a *physical standard is also inscribed,* is reported[52] from the Reddy or Kakatiya kingdoms of the period 1325 AD to 1448 AD. In this kingdom it was a custom to sketch a a portion of the measuring rod on a pillar in the temple. A Sanskrit inscription at Moparru (Ep. Coll. No. 659 of 1920) defines the units as follows:

> Half the circumference of a thumb is an angula. Twelve angula make one vitasti and thirty-two vitasti one dandaka.

The Telugu passage states that the Kesaripati-gada is equivalent to the dandaka. The sketch of a jena *i.e.* vitasti drawn on one of the sides of a pillar in the Dandeswaraswami temple at Prattipadu temple (Ep. Coll., No. 145 of 1917) *measures exactly one and a half foot or eighteen inches with a footrule* (*i. e.* 45.72 *cm.*)

The inscription further states that 112.5 kunta, measured with this gada, make one kesaripati-tumu. Twenty kesaripati-tumu made one putti.

(5) An inscription of the 13th century from Nellore [52] district defines the nivartana (N.D., I.I. C.P., No. 17, V., 28. p. 147) as follows:

> Ten hasta make one danda; thirty danda make one nivartana; ten nivartana make a gocharma.

Paurusha of Arthasastra

The connection among all these inscriptions would be clear only if we assume that the paurusha or garhapatya dhanu of 108 angula mentioned in the *Arthasastra* is the basic length mesure used. This measure in turn is twice the hasta of 54 angula which was

prescribed for use in measuring areas of timber forests (*See* Part 1). This measure and its various multiples and sub-multiples formed the foundation of a large number of South Indian land measures as shown later.

The paurusha 1.9286 m. (*See* Part 1). We assume this to be the kol of inscription (1) above and further, for rough calculation that exactly 76 kol made the side of the mattar. Then :

$76 \times 1.9286 = 146.5736$ m should be the side of the mattar.

So mattar$=(146.57\ \text{m})^2 = 21482.76\ \text{m}^2$

Now according to inscription (2) :

900 kamma$=$mattar$=21482.76\ \text{m}^2$

$\therefore$ kamma$=21482.76\ \text{m}^2 = 923.8697\ \text{m}^2$

$\therefore$ The side of the kamma $= \sqrt{23.8697\ \text{m}^2}$
$= 4{\cdot}88$ m

An important point ought to be noted. If we take 10 kamma *i.e.* 238.697 m^2, the side of 10 kamma$=\sqrt{238.697}=15.4508$ m. This is an extremely interesting result. It is *almost equal to* $8 \times 1.9286 = 15.4288$ *m.* The difference between the two values is *15.4508—15.4288=2.2 cm i.e. 1 : 700,* which is negligible.

Important Units Derived

In the above analysis, we have assumed that there were exactly 76 kol in the mattar. The difference of 2.2 cm between two values derived from two sources, though negligible, ought to be taken into account if we wish to examine the traditions in the light of the units mentioned in the *Arthasastra.* So we revise the above units, replacing 15.4508 m by 15.4288 m. The following note worthy results are obtained :

10 kamma$=(15.4288\ \text{m})^2 = 238.0479\ \text{m}^2$

$\therefore$ kamma$=23.80479\ \text{m}^2$

$\therefore$ side of kamma$=\sqrt{23.80479}=4.879$ m

It should also be noted that the kamma is a thousandth part of the *Arthasastra* paridesa based on 54 angula (23804.8 m^2 of Table 5, Part 2 of this article).

Now, mattar$=$900 kamma$=23.80479 \times 900$
$=21424.308\ \text{m}^2$

$\therefore$ 76 kol, which form the side of the square of the mattar $=\sqrt{21424.308}=146.3704$ m.

The side of the mattar, therefore, would be 75.895 kol $(146.3704 \div 1.9286)$ *and not* exactly 76 as assumed earlier. In the process of rounding off it easily became 76. *Strangely* enough, $(75.895)^2 = 5760$. This immediately reminds us of the *Arthasastra* nivartana of 57600 sq. hasta. We may assume that this unit of 5760 was derived from another unit, ten times higher (21.424308 hectare). *We shall refer to this again* while examining inscription (5).

We should carefully note the units just derived for the purpose of further analysis of South Indian traditions.

Kunta Tradition

Now let us examine inscription (4). Here the jena is 45.72 cm or 18 in as measured by the footrule. Minor corrections to this length may be necessary but we shall carry the analysis further before examining the correction required. Now, as measured :

Jena$=45{\cdot}72$ cm

$\therefore$ 32 jena$=$Kesaripati-gada $=45{\cdot}72 \times 32$
$=14{\cdot}6304$ m

This gada is about 7 mm smaller than tenth part of the length of the so called 76 kol mattar calculated above *i.e.* 14.637 m. This introduces an error of 0.2 mm between the measured and the calculated values of the jena which is impossible to detect with a footrule on a stone pillar.

The equations of inscription (4) may now be worked out as follows taking the gada to be 14.637 m :

angula = 3·8117 cm
12 angula = 1 vitasti (jena) = 45·74 cm
32 vitasti = 1 kesaripati-gada = 14·637 m
= (dandaka)
Kunta = $(\text{dandaka})^2$ = 214·24308 m^2 .
112·5 kunta = 1 Kesaripati-tumu = 24102·35 m^2
20 Kesaripati-tumu = 1 putti = 48·20469 ha.

(The jena of 42.72 cm can also be derived from the *kamsa* of 32 angula (57.14 cm) mentioned in the *Arthasastra*. In fact, the danda of 192 angula is defined as 6 *kamsa* in the *Arthasastra*. But South Indian traditions can be explained satisfactorily if we take it as 8 hasta *i.e.* $24 \times 8 = 192$ angula and treat other area units similarly. The kamsa does not seem to have much importance in South Indian area measures. We may have occasions to use it when examining area measures in the rest of India.

The jena of 45.72 cm could then be treated as the tenth part of 8 kamsa *i.e.* $\frac{57.1 \times 48}{10} = 45.71$ cm as there is not much support in available literature for this derivation, it has not been used further in this article).

It should be made clear that though the above analysis is based on the *Arthasastra* units, the nivartana does not indicate the same unit as in *Arthasastra*. One hundred kunta above make the mattar *i.e.* nivartana. This tradition of the main and sub-unit being 100 times the other is seen to advantage in the measures called kani and ma, which occur in many old inscriptions.

Kani and Ma

According to the usual definitions, the kani, ma and veli are related as follows:

ma

16 jena = 1 kol
1 sq. kol = 1 kuli
100 kuli = ma
20 ma = veli

kani

32 jena = 1 kol
1 sq. kol = 1 kuli
100 kuli = 1 kani
5 kani = 1 veli

The words kol and kuli indicate different measures in this table. The veli has the same magnitude in both the cases.

The two kol measures were in use since ancient times but were again standardized at the end of the 18th century by Royaji, the Dewan of Muhammed Ali (Wallajah), Nawab of Karnatak[25,41]. Their lengths worked out to 12 ft (3.6576 m) and 24 ft (7.3152 m) respectively. The areas of ma, kani and veli then are 1337.8 m^2, 5351.2 m^2 and 2.67 hectares respectively (14,400 ft^2, 57,600 ft^2 and 6.6. acres). It should be obvious that the Kesaripati-gada and the length units are related as $1 : \frac{1}{2} : \frac{1}{4}$. On the basis of the Kesaripati-gada, therefore, the values of the two kol would be :

$$\frac{14 \cdot 63704}{2} = 7 \cdot 31852 \text{ m}$$

$$\frac{14 \cdot 63704}{4} = 3 \cdot 65926 \text{ m}$$

The magnitudes of ma, kani and veli derived from these units would be:

ma = $(3 \cdot 65926)^2 \times 100 = 1339 \cdot 019$ m^2
kani = $(7 \cdot 31852)^2 \times 100 = 5356 \cdot 077$ m^2
veli = $(5 \times \text{kani})$ or $(20 \times \text{ma}) = 2 \cdot 678038$ ha

It may also be mentioned[53] that :

500 kuli = 5 ma = kurukkam = 6695·1 m^2

It should be noted that the kani and ma are respectively equal to 1/10 of the *Arthasastra* nivartana based on the 54 angula hasta (*See* Table 5, Part 2 of this article). The kani is also equal to 25 kunta of 214.24 m. The veli is half of the nivartana. Further, both the kani and ma are also in agreement with those standardized from ancient traditions by Royaji.

Nivartana Transformed

After examining inscriptions (1) to (4), we may now find out how inscription (5) also falls into the pattern.

We noted earlier that the nivartana or mattar was equal to a square with a basic side of 75.895 kol, the kol being 1.9286 m garhapatya dhanu or paurusha of *Arthasastra* i.e. twice the hasta of 54 angula. The square of 75.895 is 5,760. If we can find a unit having, 57,600 sq. units, this new nivartana would merely be one-tenth of it. The *Arthasastra* nivartana is 57,600 square units. Inscription (5) fulfils these requirements. We may evaluate the equations of inscription (5) directly, taking the nivartana as equal to mattar (21424.308 m^2) and also by treating the gocharma in the tradition of the *Arthasastra nivartana.*

hasta =48·79 cm (19·21 in)
10 hasta =1 danda=4·879 m (16·01 ft).
30 danda =1 nivartana=146·3708 m
1 nivartana=$(146\cdot37\ m)^2$=mattar=900 kamma =21424·3 m^2
1 gochma=10 nivartana=21·424303 hectares

Let us now divide the gocharma into 57,600 square units.

$$\frac{214243.08\ m^2}{57{,}600} = 3\cdot7194979\ m^2.$$

Now $(1.9286\ m)^2 = 3.7194979\ m^2$

So the statements made in inscriptions (1) to (5) corroborate each other in every detail.

We must remember one important point. The *Arthasastra* traditions have been modified in inscription (5) in a peculiar manner, particularly the division of the danda into 10 hasta, instead of 8 as in *Arthasastra*. This results in a new hasta unit. The gocharma would be equal to the *Arthasastra* nivartana with the 108 angula paurusha as the unit. It is also 4 times the *Arthasastra* nivartana of 53561 m^2 or 5.5361 ha. (*See* Table 5, Part 2 of this article).

The word kani in Tamil is said to mean 1/80th part. A glance at the earlier calculations will show that the kani is 1/80th of the double gocharma i.e. 20 nivartana, ($214243.08\times2/80=5356.077\ m^2$). The popularity of the number 20 for the final unit *viz* 20 ma=veli, 20 kudu=1 khanduga, 20 kesaripati tumu=1 putti, etc. is a peculiar feature of South India. It should not, therefore, be surprising if kani was taken as 1/80th of 20 nivartana (mattar)

Khanduga Tradition

The khanduga is a unit which is supposed to be the area of land that could be sown with a khanduga measure of seed. The unit thus appears to be very vague, but some estimates, which are said to be near the truth, have been made in the past. According to one of the most commonly used traditions[54] there were two different khanduga, one for dry land and one for wet land. The estimated areas of the various units are as follows:

Unit	Dry Land		Wet Land	
	yd^2	m^2	yd^2	m^2
payali or padi	200	167·225	31¼	26·129
2 padi =1 seer	400	334·451	62½	52·258
2 seer =1 balla	800	668·90	125	104·516
4 balla =1 kudu	3,200	2,675·6	500	418·064
20 kudu=1 khanduga	64,000	53,152	10,000	8,361·3

Each of these tables deserves detailed consideration. Examining the dry land units, we notice immediately that the khanduga is almost 1/4 of gocharma of 21.4243 hectares derived above and is consequently equal to 2250 kamma as kamma=23.80479 m². The difference between the estimate and this value is only 0.1 per cent.

The wet land area units have to be evaluated in terms of the square of the paurusha (garhapatya dhanu). The khanduga works out equal to 2250 such units. The difference between the estimated and the calculated values is less than 0.1 per cent. The khanduga, therefore is not just an estimated area but a definite and well-measured area unit. The following table summarises the above analysis:

Unit		Dry Land		No. of Kamma	Wet Land		No. of Square Paurusha
		Estimated m²	Calculated m²		Estimated m²	Calculated m²	
Payali or padi		167·2	167·4	7·031	26·13	26·15	7·031
2 padi	=1 seer	334·5	334·8	14·062	52·26	53·30	14·062
2 seer	=1 balla	668·9	669·5	28·125	104·5	104·6	28·125
4 balla	=1 kudu	2,676	2,678	112·5	418·1	418·4	112·5
20 kudu	=1 khanduga	53,512	53,561	2,250	8,361	8,369	2,250

The dry khanduga is also equal to the *Arthasastra* nivartana of 53561 m² based on the 54 angula hasta (*see* Table 5, Part 2 of this article) *i.e.* 57,600 square hasta. It is also ten times the kani derived earlier and 40 times the ma and twice the veli of 2·678 ha.

It will be noted that all the main units we have considered *viz* mattar, nivartana, kunta, kani, ma, khanduga have all a definite relation one with the other and with the nivartana and paridesa of *Arthasastra* shown in Table 5, Part 2 of the article.

We have so far discussed the more important ancient units based on the *Arthasastra* garhapatya dhanu, or paurusha of 108 angula (1.9286 m). A large number of other comparatively modern area units based on this length measure will be examined in Part 4.

Goru Tradition

We may now examine area units based on length measures other than the 108 angula of paurusha of *Arthasastra.* In some regions of South India, there were in use area measures based on the hasta of 19.7 in *i.e.* 50 cm. The tradition of the goru is historically interesting and occurs in many inscriptions in the Andhra Pradesh area. The general equation[47,55] with equivalents calculated on the basis of the 50 cm hasta is as follows :

32 hasta=1 rod=16 m

1 rod square=1 kunta=256m²

50 kunta=1 gurtu or goru=12,800 m²=1·28 ha

8 gurto=1 kuchchala=1,02,400 m²=10·24 ha.

This kuchchala is obviously 16 times the paridesa having a side of 80 metres (*see* Tables, Part 2). In Part 4, we shall have occasion to discuss many area units based on the 50 cm hasta.

Adi

There is another peculiar length unit which also enters into many ancient area measures. It is called the adi. The varieties of this adi and its peculiarities are so many that it does not lend itself easily to analysis. It is, however, examined in Part 4 in the light of modern data.

So far we have seen that most of the important area measures used in South India in ancient times had a definite relation with the *Arthasastra* units. This harmony becomes discordant later on because many tenuous liberties were taken with the ancient units. For example, in the Vijayanagar empire land was measured with a kol of 18 feet (adi) up to 1447 AD, but the kol was increased to 20 feet (adi) so as to mellow down the rigours of taxation[47]. If such a tradition survives it can only serve to confuse the land measures later on.

Having analysed some of the commonly used ancient land measures, we shall examine in Part 4, other important but comparatively later measures mentioned in British records of the 17th-19th centuries.

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Coal Mines Rescue Rules Amended

Dated New Delhi, the 11*th Jan.*, 1963

Notification

GSR/122 in exercise of the powers conferred by clauses (r) to (w) of section 58 of the Mines Act, 1952 (35 of 1952) the Central Government hereby makes the following rules further to amend the Coal Mines Rescue Rules, 1959, the same having been previously published as required by sub-section (1) of section 59 of the said Act, namely :—

(1) (i) These rules may be called the Coal Mines Rescue (Second Amendment) Rules, 1963.

(2) They shall come into force on the 1st March, 1963.

(2) In the Coal Mines Rescue Rules, 1959 (hereinafter referred to as the said rules), in sub-rule (1) rules 13, for the figure and words, '2 naya paise', the figure and words '1/3 naye paise' shall be substituted.

(3) For rule 16 of the said rules, the following rule shall be substituted, namely—

'Location and Maintenance of Rescue Stations

(1) The Committee shall establish and maintain rescue stations of such standards, in such numbers and located at such places as the Central Government may consider necessary for providing rescue facilities to the Coal Mines to which these rules apply.

(2) The Chief Inspector shall, in consultation with the Committee, notify the coal mines served by each rescue stations.'

(4) In the first proviso to rule 21 of the said rules, for the words, 'two miles', the words, 'three kilometres' shall be substituted.

(5) In schedule 1 to the said rules, in item (2) for the figures and word '120 feet', the figures and word, '36 metres' shall be substituted.

(6) In part 1 of Schedule V to the said rules, under sub-heading 'B Practices', in paragraph (c),

(i) in item (i) for the words, figures and notation 'a weight of 56 lb. to and from a height of six feet', the words and figures. 'a weight of 25 kilograms to and from a height of 1·8 metres' shall be substituted; (ii) in item (iii), for the words 'thirty feet' the words 'ten metres' shall be substituted; (iii) in item (vi), for the figures and notation '150 lb.', the figures and word '70 kilograms' shall be substituted.

[F. No. 1/17/62-MI/Am(4)]

R. C. SAKSENA,
Under Secretary to the Govt. of India.

(Published in Part II Section 3(i) of the Gazette of India dated 19-1-63).

Change-over in Sizes of Readymade Clothes

It is understood that the Clothing Manufacturers Association of India, Bombay, has informed all its members that from 1 Mar. 1964, new metric sizes would be adopted for designating the sizes of various clothes like Manilla shirts, pyjama suits, dressing gowns, trousers (waist), shirts etc.

In the case of shirt sizes, instead of collar sizes from 13½ to 17½ inches, the following centimetre sizes would be adopted :

34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44. This means that instead of selecting from nine shirt sizes which are now prevalent, customers could make their choice from 11 sizes. Manilla shirts, pyjama suits and dressing gowns are now sold in chest sizes ranging from 32 inches to 42 inches. The new metric sizes would be in centimetres : 80, 85, 90, 95, 100, 105, 110, 115. Here also from the old 7 sizes, after the change-over there would be 8 sizes for selection.

Trousers are normally sold in waist dimensions. The new centimetre sizes would be 70, 75, 80, 85, 90, 95, 100, 105. The old sizes were ranging from 28 to 42 inches by steps of 2 inches.

Until the new range of sizes is introduced, the garments will carry a hang-ticket, or some stamping arrangement will be made to indicate the existing inch sizes converted into approximate centimetres.

It is understood that the Association is also devising new metric sizes for many other readymade clothes.

The Association has apparently given considerable thought to the change-over and have now decided to adopt rational sizes in metric units, so that odd sizes in metric units are avoided.

International Committee on Weights & Measuers Meets

At the 52nd meeting of the International Committee of Weights and Measures, held in October 1963, in Paris, a number of important decisions were taken :

(1) It was decided that the 12th General Conference of Weights and Measures, originally scheduled to be held in 1966, should be convened in October 1964. Normally, the General Conference meets every 6 years. The 11th General Conference was held in October 1960. The interval has been reduced because the International Committee found that the 6 year period between Conferences was too long.

(2) At the 12th General Conference, a proposal to double the present budget would be put before the participating countries. Extra contributions would also be asked for to facilitate the equipping of a laboratory for standards for measuring ionizing radiations.

(3) If the increased budget is approved, the International Bureau would also undertake work on the improvement and extension of the temperature scale and the realization of the full potential afforded by the wavelength definition of the metre.

(4) The Committee is also studying the programme of precision measurements at very high radio frequencies. In the light of recent developments, the co-ordination of measurements at very high radio frequencies has become pressing.

(5) If the work now in progress matures, a proposal to define the second in terms of an atomic constant would be placed before the Conference for approval.

(6) The litre and the cubic decimetre are slightly different. This difference, which is of the order of 28 parts in a million, frequently causes difficulties in precision measurements

The International Committee will recommend to the General Conference that the litre and the cubic decimetre should be identical in value and the old definition of the litre should be given up. The word litre, however, will be recognised as a special name for the cubic decimetre.

(7) Among the secondary standards of length approved by the Committee were four additional transitions in krypton 86, four transitions in mercury 198, and four in cadmium 114.

(8) The Committee has recognised the curie, (Ci.), as a special unit of activity equal to $3{\cdot}7 \times 10^{10}$ disintegrations per second.

(9) Roentgen, (R), has also been recognised as a special unit for radiation dose.

(10) An international journal *Metrologia* would be started under the editorial guidance of the International Committee. Formal announcements are expected shortly. The new journal will publish articles on research in the fields of precision measurements and the development of standards. Review articles in various branches of metrology will also be an important feature of the journal. The articles will be published in the language used by the author.

Standards News

(Indian standards which have a particular bearing on change-over to the metric system are indicated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi or their Branch Offices at Bombay Calcutta, Madras and Kanpur.)

Cold Rolled Carbon Steel Sheets (IS : 513—1963)

The Indian Standards Institution has published the first revision of Indian Standard Specification for Cold Rolled Carbon Steel Sheets (IS : 513-1963), which covers the requirements for the following types of steel sheets :

O Ordinary, DD Deep drawing and
D Drawing, EDD Extra deep drawing.

This standard was first issued in 1954 as Specification for Special Qualities of Steel Sheets. In view of the decision of the Government of India to change-over to metric system, the revision of this standard has become necessary. This standard covers the requirements for cold rolled carbon steel sheets up to 1·6 mm thickness required for panelling, enamelling, deep drawing and for general engineering purposes. Sheets conforming to this standard are of weldable quality and are suitable both for fusion and spot welding.

Price : Rs. 2.50

Hot Rolled Carbon Steel Sheet & Strip (IS:1079-1963)

The Indian Standards Institution has published the first revision of Indian Standard Specification for Hot Rolled Carbon

Steel Sheet and Strip (IS : 1079-1963), which covers the requirements for five grades of hot rolled carbon steel sheet, strip and coiled strip intended for the manufacture of cold formed structural members and for other general engineering purposes. Sheet and strip shall have the following ranges of thicknesses and widths :

Thickness	Below 5 mm
Width :	
Sheet	600 mm and above
Strip	Below 600 mm

This standard was first issued in 1958 as Specification for Light Gauge Structural Quality Hot Rolled Carbon Steel Sheet and Strip. In view of the decision of the Government of India to change-over to metric system, the revision of this standard has become necessary. This standard covers the requirements for five grades of hot rolled carbon steel sheet, strip and coiled strip intended for the manufacture of cold formed structural members and for other general engineering purposes. The five grades are designated as 0-1079, St 34-1079, St 42-1079, St 50-1079 and St 52-1079 respectively. Grades St 34-1079, St 42-1079 and St 52-1079 (surface descaled) included in this standard are of weldable quality. For spot welding, only Grade St 34-1079 steel is recommended, as spot welding becomes increasingly difficult with carbon is excess of 0·15 per cent.

Price : Rs. 1·50

Steel Tubes for Structural Purposes (IS : 1161—1963)

The Indian Standards Institution has published the first revision of Indian Standard Specification for Steel Tubes for Structural Purposes (IS: 1161-1963), which covers the requirements for plain carbon steel tubes for structural purposes not exceeding 225 mm nominal bore of the following types :

HFW—Hot finished welded.

HFS—Hot finished seamless.

ERW—Electric resistance or induction butt welded.

This standard was first issued in 1958 and specified the requirements for plain carbon steel tubes for structural purposes and does not cover tubes required for pressure purposes. In this revision, certain additional tube sizes have been included, and all the clauses.

This specification is one of a series of Indian Standards for commercial metric weights and measures being prepared by the Indian Standards Institution.

Price. : Re. 1.00

Rectangular Tins (IS : 1406—1963)

The Indian Standards Institution has published the first revision of Indian Standard Specification for Rectangular Tins (IS : 1406-1963), which covers the requirements of 10-litre, 5-litre, 3-litre, 2-litre, 1 litre, 500-millilitre and 250-millilitre rectangular tins manufactured from tin plate, and normally used for packing liquids.

The rectangular range of tins is perhaps the most generally useful and familiar form of liquid containers in the market today. It is certainly one of the most popular among manufacturers, retailers and the public. The rectangular tins are used for packing burning oils, lubricating oils and solvents, insecticides and disinfectants, varnishes and paints, paint strippers, soldering fluids, brake fluids, liquid can cleaners, essential oils and numerous other products.

Till recently, it has been the common practice to market the products packed in these containers in gallons. It is considered that the adaptation of the metric sizes covered by this standard will be advantageous to the industry and that all packers and users will use this standard as a guide and select their range of sizes of tins accordingly.

This standard as originally issued in 1959 covered four sizes, namely, 5-litre, 1-litre, 500-ml and 250-ml only. Subsequently, there was need for introducing the 10-litre size largely used for gasoline and for sandalwood oil. The paint trade was also in the need of the 3-litre and 2-litre sizes. This revision provides for these additional sizes. In addition, requirements for the corner radius have also been introduced; and overall height and inside height requirements have been replaced by those for overseam height in line with the practice adopted in other Indian Standards on metal containers.

Price : Rs. 2·00

Large Metric Capacity Calibrating Measures (Non-Tilting Type) (IS : 2341—1963)

The Indian Standards Institution has published Indian Standard Specification for large Metric Capacity Calibrating Measures (Non-Tilting Type) (IS: 2341-1963), which covers the requirements of large metric capacity calibrating measures of the stationary and portable types intended for use in checking commercial bulk measures, vehicle tanks, bulk meters, etc.

Measures up to and including 20 litres are covered by IS: 1058-1962 Specification for Commercial Metric Capacity Measures (Revised). For calibrating bulk vehicle tanks, meters and large filling measures, it is necessary to have large capacity calibrating measures. It was realized that Controllers of Weights and Measures would require these measures, and that in the interests of uniformity, an Indian Standard was called for. It was felt that such a standard giving essential constructional features would also assist in the manufacture of measure of reliable quality.

Price : Rs. 2·00

Specification for Water Meters (Domestic Type) (*Revised*).

While the manufacture of domestic water meter has made considerable strides in the country, manufacture of bulk water meters is still in the initial stages of development, and most of the requirements are being met by imports. It is hoped that this standard will give useful guidance to the indigenous bulk water-meter industry, in making rapid development and also in making meters of satisfactory quality and adequate performance level.

Price : Rs. 4·00

Water Meters (Bulk Type) (IS : 2373—1963)

The Indian Standards Institution has published Indian Standard Specification for Water Meter (Bulk Type) (IS: 2373-1963), which covers inferential (horizontal flow) water meters including 'full-flow' type, ranging in size from 40 mm up to and including 300 mm and semi-positive meters ranging in size from 40 mm up to and including 100 mm, both types having flanged end connections. This standard applies to both wet and dry dial meters.

This standard covers the requirements for bulk water meters generally used in metering supplies to large consumers, such as industrial installation, block of flats or bungalows, drawing supply from a single main, and estates. Requirements for domestic water meters have already been covered by IS: 779-1961 relating to general requirements for the supply of material conforming to this standard have been deleted and a reference has been made to IS: 1387-1959 General Requirements for the Supply of Metals and Metal Products.

Price : Rs. 3·00

Licensed Manufacturers and Repairers

(*Metric Measure* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A feature on statistics of verification and licences issued is also being published in *Metric Measures*.)

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENCES

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Others	Total number of Mfrs.	Dealers	Repairers As on 31st May, 1964
(1) Andhra Pradesh	1st Oct. '62 to 31 March '63.	2,00,101	64,362	6,408	21,747	527	26	14	59	24
(2) Assam	1st Apr. to 30 Nov. '63.	2,05,852	58,406	5,570	1,668	70		17	210	145
(3) Bihar	1 Apr. '62 to 31 Jan. '63.	1,28,211	—	—	19,309	56		30	203	43
(4) Gujarat	—	1,19,006	7,987	1,005	19,155	174	—	105	570	145
(5) Kerala	1 Apr. '62 to 31 July '62.	—	—	—	—	—	—	73	459	142
(6) Jammu & Kashmir	1st Oct. to 30 Nov. '63.	10,043	868	1,377	1,286	20	8	8	171	10
(7) Madhya Pradesh	—	—	—	—	—	—	—	—	—	—
(8) Madras	—	—	—	—	—	—	—	—	—	—
(9) Maharashtra	1 Apr. '62 to 31 Mar. '63.	18,74,286	5,37,135	33,988	—	—		—	—	—
(10) Mysore	1 Apr. '62 to 31 Nov. '62.	4,81,354	1,05,253	1,037	59,674	8,420		126	493	92
(11) Orissa	1 Apr. '62 to 31 Mar. '63.	4,23,597	86,060	3,089	1,596	2		8	103	6
(12) Punjab	1 Apr. '62 to 30 Sept. '63.	15,01,606	84,078	41,826	2,07,347	407	—	10	34	2

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Instruments	Others	Total number of As on 31st May, 1964		
								Mfrs.	Dealers	Repairers
(13) Rajasthan	N.A.	—	—	—	—	—	—	—	—	—
(14) Uttar Pradesh	1st June to 30 Nov. '62.	8,95,335	8,897	20,506	7,505	298	—	200	979	187
(15) West Bengal	Up to 23 Mar. '64.	46,09,820	65,000	15,007	2,57,173	—	—	116	684	80
(16) A and N Islands	N.A.	—	—	—	—	—	—	—	—	—
(17) Delhi	1st Oct. to 30 Nov. '63.	41,094	4,139	1,386	6,028	16	—	26	70	24
(18) Goa	1 Apr. to 31 May, '62.	18	3	—	—	—	—	—	—	—
(19) Himachal Pradesh	1 Apr. '62 to 31 July '63.	68,020	7,411	2,532	10,628	1	—	1	25	12
(20) L.M.A. Islands	1 Apr. '62 to Oct. '63.	—	—	—	—	—	—	—	—	—
(21) Manipur	1 Apr. '63 to 31 Dec. '63.	19,835	4,115	239	599	8	—	—	—	—
(22) Pondicherry	1st Apr. to 30 Nov. '63.	5,403	4,591	5	678	8	—	14	62	7
(23) Tripura	1 Apr. '62 to 30 July '62.	62,050	8,464	720	9	8	—	4	85	3

N.A.—Statistics not available as yet.

GUJARAT

Manufacturers and Repairers licensed during 1st October to 31st December, 1963.

MANUFACTURERS

Sl. No.	Name and Address of Manufacturers	Details of Articles Manufactured
(1)	Ambica Scale Manufacturing Works, Mangaldas Photographer's Chali, Behind Kasturbhai's Ghali Opp. Ashok Mill, Naroda Road, Ahmedabad.	Weigh-Bridges.
(2)	Luhar Bechar Narshi, Nadi Kantha, Savarkundla.	Beam Scales Class (C & D)
(3)	Luhar Jadav Jiva, Jamadar Pada, Savarkundla.	Beam Scales Class (C & D).

REPAIRERS

(1) Bhagwan Kakabhai, Savarkundla.

(2) Bhailal Gordhanbhai Panchal, Jambusar, District Broach.

(3) Chhaganlal Maganal, Oravad Sheri, Kalvad (Sitla).

(4) C. & G. Chokshi, Rajkot.

(5) Dinishing Scale Repairing Works, Salapose Road, Ahmedabad.

(6) National Scales and Weights Repairing Works, Danapith, Bhavnagar.

(7) Roshan Scale Repairing Works, Bhavnagar.

(8) Veraval Lokhand Kam Karigar Sahakari Mandli Ltd., Veraval.

LICENSED MANUFACTURERS AND REPAIRERS

PONDICHERRY

List of manufacturers and repairers of weights, measures and instruments licensed during the period from 1-4-1963 to 31-11-1963.

MANUFACTURERS

Sl. No.	Name and Address of Manufacturers	Details of Articles Manufactured
(1)	Honesty Engineers & Contractors, 3, Bis, Surcouf St., Pondicherry.	Peg Measures and Beam Scales Class C & D.
(2)	Jayam Engineering Works, 258, West Boulvard, Pondicherry.	Weighing Instruments Class C & D.
(3)	M. Kannan, 9/63, Vazakulam, Pondicherry.	Cylindrical and Conical capacity measures, and metal length measures.
(4)	V. Latchumanan, North Boulvard, Pondicherry.	Cylindrical and Conical capacity measures, and metal length measures.
(5)	Raju Achari, 81, Barathi Street, Pondicherry.	Bullion Weights.
(6)	Swamy Foundry, 232, Bis West Boulvard, Pondicherry.	Cylindrical and Conical capacity measures, and metal length measures.
(7)	Tamilarasan Industries, 160, North Boulvard, Pondicherry.	Cylindrical and Conical capacity measures, and metal length measures.

REPAIRERS

(1) Avery & Co., of India (Private) Ltd., 16-17, Armenian Street, Madras-1.

(2) Honesty Engineers and Contractors, 3, Bis, Rue Brcouf, Pondicherry.

(3) T. Natesa Achari, 78, Mahatma Gandhi Road, Pondicherry.

(4) Thiagaraja Engineering Works, Market, Karaikal.

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Serial No.	Commodity	Metric Unit
(1)	**Gold**	10 grams (g)
(2)	**Grocery and Confectionery** Biscuits, sweetmeats, cardamoms. **Textiles and Textile Fibres** Cotton yarn, damaged and seconds cloth, raw silk, rayon silk yarn, raw wool, wool manufactures (when sold by weight). **Paints & Chemicals** Paint (if sold by weight), indigo, liquid chlorine. **Hides, Skins & Leather** Raw hides, leather (hides and skins). **Metals** Silver, aluminium sheets, strips and circles, copper and brass wires and utensils. **Miscellaneous** Tea, meat, camphor tablets, mica.	1 kilogram (kg)
(3)	**Grains and Pulses** Rice, wheat, jowar, arhar, moong, masur, gram. **Spices** Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts. **Plantation Products** Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured). **Forest Products** Lac and lac products, gums, myrobalans, galnuts, soapnuts. **Textiles & Textile Fibres** Raw jute, raw hemp, coir yarn. **Oils, Oilseeds & Oilcakes** Vegetable oil, oilseeds, oilcakes. **Non-Ferrous Metals** *Aluminium* : ingots, bars, blocks, slabs, billets. *Lead* : ingots, sheets and strips. *Copper* : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles. *Brass* : ingots, rods, sections, pipes, sheets, strips, circles. *Zinc* : ingots, sheets, strips. *Tin* : blocks.	1 quintal (q) (100 kilograms)
	Chemicals Caustic soda, bleaching powder, glycerine, soaps, paper salt. **Others** Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals** Iron ore, manganese ore, bauxite, coal. **Iron & Steel** Pig iron, iron & steel manufactures, semis (billets for rerolling etc.)	one metric tonne (t) (1,000 kilograms)
(5)	Cloth (mill, handloom, silk rayon and woollen cloth)	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

ABBREVIATION FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUB-MULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
Kilo	..	1,000	k
centi	..	0·01(10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	u

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1,000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	.	1 mg	mg
carat	.	200 mg	c
(3) CAPACITY			
kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml
(4) VOLUME			
cubic metre	.	m^3	m^3 or cu m*
cubic centimetre	.	cm^3	cm^3 or cu cm*
cubic millimetre	.	mm^3	mm^3 or cu mm*
(5) LENGTH			
kilometre	.	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	.	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	um
(6) AREA			
square kilometre		1 000 000 m^2	km^2 or sq km*
square metre	..	1 m2	m^2 or sq m*
square centimetre		1 cm^2	cm^2 or sq cm*
square millimetre		1 mm^2	mm^2 or sq mm*
(7) LAND MEASURE			
are	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20 g, 5 g, 10 t, 20 ml, 271, 165 km, 2 mm, 100 cm^3, 66 km^2.

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM; the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.

(3) Do not use any other abbreviations except those given above.